Check List the journal of biodiversity data

NOTES ON GEOGRAPHIC DISTRIBUTION

Check List 17 (1): 13–20
https://doi.org/10.15560/17.1.13

PENSOFT.

Unexpected finds in Bahia: first records of five species of *Tillandsia* L. (Bromeliaceae)

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Abstract
We present the first records of five *Tillandsia* L. species from the state of Bahia, Brazil, which were collected in the field and studied in herbaria. *Tillandsia didisticha* (E.Morren) Baker occurs in Cerrado and Caatinga biomes, *T. linearis* Vell. and *T. dura* Baker in Atlantic Forest fragments, and *T. pruinosa* Sw. and *T. grao-mogolensis* Silveira in an ecotonal transition zone between dry and humid forest. We present photographs, taxonomic notes, distribution ranges of these species in Bahia and discuss their morphological distinctions.

Keywords
Biodiversity, bromeliad, geographic distribution, Poales, taxonomy, Tillandsioideae

Academic editor: Matias Köhler | Received 22 September 2020 | Accepted 11 December 2020 | Published 5 January 2021

Citation: Leodegario MM, Cavalcante BP, Aona LYS, Wanderley MGL, Souza FVD, Souza EH (2021) Unexpected finds in Bahia: first records of five species of *Tillandsia* L. (Bromeliaceae). Check List 17 (1): 13–20. https://doi.org/10.15560/17.1.13

Introduction

Tillandsia L. (subfamily Tillandsioideae) is the most species-rich genus of Bromeliaceae, currently presenting 750 species in seven subgenera: *Aerobia* Mez, *Anoplophytum* (Beer) Baker, *Diaphoranthema* (Beer) Baker, *Phytarrhiza* (Vis.) Baker, *Pseudovriesea* Barfuss & W.Till, *Tillandsia* and *Viridantha* (Espejo) W.Till & Barfuss (Barfuss et al. 2016; Gouda et al. 2020). Species of *Tillandsia* are distributed throughout South and Central America and the southern United States, where they colonize humid to dry forests from sea level to high altitudes (Benzing 2000; Givnish et al. 2011; Gouda et al. 2020). The ecological plasticity of *Tillandsia* species allows for their occurrence in a variety of environments with many edaphoclimatic conditions, and leads to various growth forms, such as rupicolous, terrestrial, epiphytic, and saxicolous (Benzing 2000; Barfuss et al. 2016).

The high adaptivity of bromeliads and the phylogenetic complexity of *Tillandsia* hamper precise species identifications due to similar morphological traits (Benzing 2000; Givnish et al. 2011; Barfuss et al. 2016). However, some morphological and habitat traits can be used to identify epiphytic, rupicolous, and rarely terricolous species of *Tillandsia* species: leaves in the form of a rosette or arranged along the stem; leaves polystichous or distichous; leaf sheath slightly widened; leaf blade linear-filiform, narrowly triangular, or lingulate; inflorescence in the form of

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a spike, raceme, set of spikes, or rarely reduced to a single erect to pendulous flower; peduncle well developed or absent; flowers polystichous or distichous; sepals free or short-connate and symmetrical; petals unicolor (yellow, blue, white, cream, orange, rose, green, red, or violet), but rarely bicolorous; appendages absent, except in subgenus *Pseudovriesea*); stamens included or exserted; fruit a septicidal capsule; seed with appendages.

So far, 109 species of *Tillandsia* are known from Brazil, of which 47 are endemic or micro-endemic to the country (Flora do Brasil 2020). In Bahia, 25 species are known occur and eight species are endemic to the state (Flora do Brasil 2020). Bahia, at over 564,000 km², stands out for having three biomes of great importance for bromeliads: the Caatinga, Cerrado, and Atlantic Forest. The high species richness of *Tillandsia* in Bahia (ca 25% of Brazilian species) is due to the complexity of the states' physiognomies, which include rocky fields and humid, high-altitude, and dry forests (Caatinga and Cerrado), as well as many ecotonal transition zones, such as gallery and coastal forests (SEMA 2020).

New records of Bromeliaceae from states of Brazil and other countries have been published (Versieux et al. 2013; Büneker et al. 2015; Lima and Soares-Silva 2016, Guarçoni et al. 2018), and include first reports of *Tillandsia* species from the states of Rio Grande do Sul (Büneker et al. 2015), Maranhão (Guarçoni et al. 2018), and Paraná (Kremer 2011) and from the Central-west region (Lima and Soares-Silva 2016). However, there are no recently published data for Bahia. The most recent survey was part of a PhD thesis by Fiorato (2009) who reported 16 species (Fiorato 2009).

Thus, we present the first records of five species of *Tillandsia* from Bahia (Brazil) and provide additional morphological, ecological, and taxonomic information. We discuss the affinities of these five species with morphologically similar species, as well as provide illustrations of their habits and morphology and notes on their conservation.

Methods

Information on the distribution and occurrence of the species reported here was based on Baker 1887, 1889, Mez 1895, Smith and Downs (1977), Winkler (1982), Siqueira-Filho and Leme (2006), Pontes and Agra (2006), Fiorato (2009) and Barfuss et al. (2016). We consulted the herbaria ALCB, CEPEC, HUEFS, HUNEB, HURB, and HVASF (acronyms according to Thiers 2020) material collected from cultures kept by the Bromeliad Germplasm Bank (BGB Bromélia) of Embrapa Cassava and Fruits (Cruz das Almas, Bahia, Brazil). Online platforms were consulted, such as Reflora (2020) and SpeciesLink (2020).

Field campaigns were conducted between 2018 and 2020 in all biomes in Bahia. All specimens collected were herborized and deposited in the Recôncavo da Bahia Herbarium (HURB). The identification and morphological study of each species included study of type material, relevant literature, and specimens in the BGB Bromélia herbarium. The morphometric studies were made from collected material, herborized specimens, and living plants in the field. The terminology used is that of Smith and Downs (1977) and complemented by Scharf and Gouda (2008) and Barfuss et al. (2016).

The occurrence map of the new records was prepared using an adapted biome map of the Superintendência de Estudos Econômicos e Sociais da Bahia (SEI 2014).

Results

We carried out field campaigns throughout Bahia to verify the occurrence of *Tillansia* species (Figs 1, 2). We increased the number of species known from Bahia from 25 to 31 species, an increase of 20%; the newly found species include: *T. didisticha* (E.Morren) Baker (in Cerrado and Caatinga), *T. linearis* Vell. and *T. dura* Baker (in Atlantic Forest), *T. pruinosa* Sw. and *T. grao-mogolensis* Silveira (in ecotone transitional zones between the Caatinga and the Atlantic Forest) (Fig. 1) and a new species, *T. itatiensis* E.H.Souza & Leodegario, which has been published elsewhere (Leodegario et al. 2020).

Tillandsia didisticha (E.Morren) Baker

New records. BRAZIL – Bahia • São Desidério, Sertaneja, ca 4 km from São Desidério in the direction to Correntina; 12°22.00′S, 044°58.45′W, 29 Aug. 2019, E.H. Souza et al. 1029 (HURB 23167). • Bahia, Santo Sé, Grota do Cumbre, 07. Oct. 2008, J.A. Siqueira Filho 1993 (HVASF 1765, HURB 25675, HURB 25663). • Santo Sé, São Pedro District; Waterfall trail; 09°54.18′S, 041° 04.87′W; 27 Jan. 2011, F.F.S. Silva et al. 179 (HURB 25662).

Identification. Plant: rupiculous or rarely epiphytic, 22–45.5 × 13–20 cm when flowering, inconspicuous stem, infundibuliform rosette. Leaves: 14–19.5 × 0.7–1.5 cm, numerous, erect or suberect, the basal ones being reflexed, green to greyish, chartaceous, sulcate; leaf sheaths similar to the leaf blades in color, oblong, 0.6–0.9 × 0.8–1.5 cm, green to yellowish, lepidote; leaf blades 11–18.5 × 0.7–1.4 cm, triangular with an attenuate apex. Inflorescence: (fertile portion) compound, 2–6 branches per inflorescence, rarely simple, 4.5–12 × 1.5–6.5 cm, 3–9 flowers per branch when branched and 14 when single. Peduncle: 11–20 × 0.18–0.35 cm, erect or slight curved, green to greyish, covered by peduncle bracts; peduncle bracts foliaceous, the basal ones density lepidote, narrowly triangular with an attenuate apex, reddish, 7.8–10.2 × 0.5–0.7 cm, the distal bracts elliptical with a cuspidate apex, reddish, lepidote, slight carinate, nerved, 1.8–2.2 × 0.6–0.7 cm. Floral bracts: elliptical, 1.8–2.1 × 0.4–0.7 cm, reddish, covering the calyx, longer than the sepals, not carinate, lepidote and with acuminate apex. Flowers: sessile, distichous, 2–2.4 × 0.3–0.5 cm; sepal soval, 1.1–1.4 × 0.4–0.6 cm, slight connate at the base, adaxially carinate, slightly lepidote, acute apex; petals ligulate, 1.6–2 × 0.2–0.4 cm, white, rounded apex.

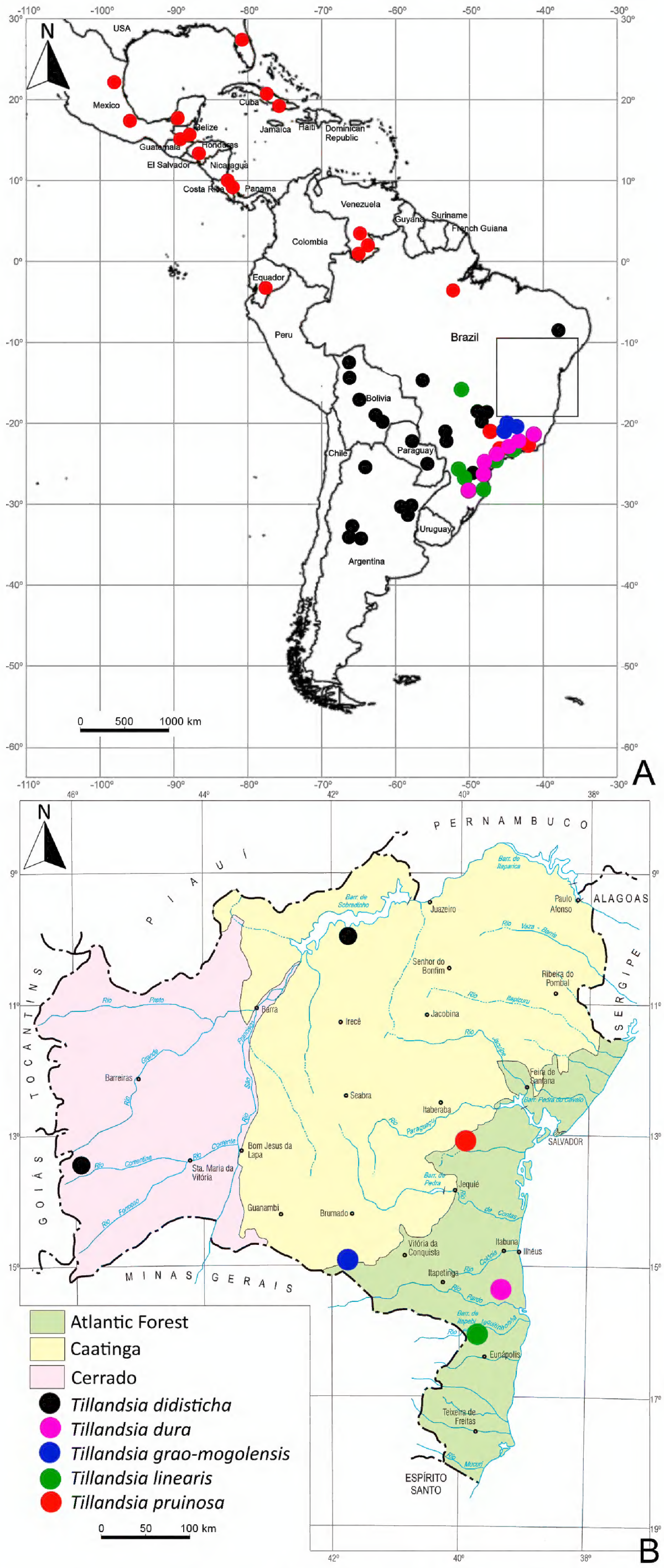

Figure 1. Geographic distribution of five species of *Tillandsia*. **A.** In the Americas. **B.** State of Bahia with biomes shown.

Figure 2. *Tillandsia* species newly reported from Bahia, Brazil. **A–C.** *Tillandsia didisticha* (E.Morren) Baker. **D, E.** *T. dura* Baker. **F, G.** *T. graomogolensis* Silveira.**H, I.** *T. linearis* Vell. **J, K.** *T. pruinosa* Sw. Photographs: A–C, F–K by E.H. Souza; D by J.E. Santos; E by S.E. Martins.

Stamens: included, erect, 1.7–2.2 × 0.04–0.06 cm; filament flatten, flaccid, sublinear, whitish, plicate at the apex, 1.2–1.5 × 0.4–0.6 mm, free; anthers yellowish, 2.8–3.1 × 0.6–0.9 mm. Pistil: surpassing the stamens, included; ovary greenish, ovoidal, 5–6.2 × 1.5–2.1 mm; style erect, whitish, 0.9–1.1 × 0.07–0.1 cm; stigma simple-erect. Capsule: 2.8–3.1 × 0.3–0.4 cm, cylindrical, glabrous, acute apex. Seeds: 4.2–5.2 mm long, fusiform, appendage 1.3–1.7 cm long.

Conservation comments. In the Parque Nacional do Boqueirão da Onça, this species occurs on inselbergs in the municipalities of São Desidério and Santo Sé. In São Desidério, it occurs in small populations in a mining area on limestone. In Boqueirão da Onça, this species has small and scattered populations throughout the Parque Nacional Boqueirão da Onça. In Bahia, the species is relatively rare and is threatened by mining activities.

Tillandsia dura Baker

New record. BRAZIL – Bahia • Santa Luzia, Gruta do Lapão, next city water system; 15°26.47′S, 039°21.24′W, Jan. 2020, E.H. Souza 203 (HURB 25809).

Identification. Plant: rupiculous or rarely epiphytic, heliophyte, 11–15.5 × 11–13.5 cm when flowering, elongated and curved stem with 12–18.9 × 0.8–1.2 cm, lignified in the basal portion close to the roots. Leaves: 12–18 × 0.4–0.6 cm, numerous, polystichous, erect to curved, green to reddish, coriaceous, slight sulcate;

sheaths chestnut-brown, oblong, 0.8–1.2 × 0.4–0.6 cm, densely and finely appressed-lepidote, sub-glabrous above with age; leaf blades 11–17 × 0.3–0.6 cm, green to chestnut-brown, lepidote, narrowly triangular, apex long-attenuate. Inflorescence: (fertile portion) simple, erect to suberect, 8–15 × 0.7–1.1 cm, 8–18 flowers per inflorescence. Peduncle: 4.3–5.4 × 0.4–0.6 cm, erect to suberect, green, covered by peduncle bracts; peduncle bracts foliaceous, the basal one density lepidote, triangular with a long-attenuate apex, reddish, 1.9–2.9 × 0.4–0.5 cm, the distal bracts oval to elliptical with an obtuse to apiculate, reddish, lepidote, slight carinate, 1.9–2.9 × 0.4–0.5 cm. Floral bracts: oblong, 1.3–1.7 × 0.5–0.7 cm, reddish, covering the calyx and exceeding the sepals in length, carinate, lepidote, apex acute. Flowers: sessile, distichous, tubular, 3.1–4.0 × 0.4–0.6 cm; sepals oblong to lanceolate, 1.4–1.9 × 0.3–0.5 cm, free, adaxially carinate, glabrous, apex acute; petals linear, 2.8–3.7 × 0.3–0.5 cm, violet but whitish at the base, apex rounded. Stamens: included, erect, 1.4–1.8 × 0.08–0.1 cm; filaments flattened, linear, plicate, whitish, free, 1.2–1.6 × 0.08–0.10 cm; anthers yellowish, 1.2–1.6 × 0.6–0.9 mm. Pistil: exceeding the stamens in height, included; ovary ovoidal, pale green, 3–4.1 × 2–2.4 mm; style erect, pale green, 2.3–3.1 × 0.04–0.06 cm; stigma simple-erect. Capsule and seeds: not seen.

Conservation comments. This species is endemic to an inselberg in the municipality of Santa Luzia and is threatened due to extraction by collectors and the intense flow of tourists in the region, including religious tourism in the municipality.

Tillandsia grao-mogolensis Silveira

New records. BRAZIL – Bahia • Cordeiros, BA-148 highway, under rocky outcrop, Bahia border with Minas Gerais, 15°02.32′S, 041°56.07′W, 29 May. 2019, E.H. Souza 173 (HURB 25000).

Identification. Plant: saxicolous, 10–20 × 10–15 cm when flowering, elongated stem. Leaves: 5–15 × 0.3–0.5 cm, few, polystichous, erect to patent, grayish to silver, chartaceous, sulcate and densely lepidote; sheaths similar to the leaf blades in color, oblong, 1.2–1.4 × 0.6–0.8 cm, greenish to yellowish, glabrous; leaf blades 4.2–14.2 × 0.4–0.5 cm, narrowly triangular with a long-attenuate apex. Inflorescence: (fertile portion) simple, distichous, lanceolate, 5–7 × 0.7–1 cm, 5 or 6 flowers per inflorescence. Peduncle: 8–12 × 0.25–0.38 cm, erect, grayish to silver, covered by peduncle bracts; peduncle bracts the basal foliaceous, densely lepidote, lanceolate with a long-attenuate apex, 5.0–6.5 × 1.8–2.4 cm, the distal ones being elliptic with acute apex, densely lepidote, 1.8–2.2 × 1.3–1.5 cm. Floral bracts: elliptic, 1.3–1.6 × 0.5–0.7 cm, green to brownish, covering the calyx and exceeding the sepals in length, lepidote with an acuminate apex. Flowers: sessile, distichous, 1.5–2 × 1.2–1.5 cm; sepals lanceolate, 0.6–0.8 × 0.3–0.5 cm, connate, carinate, lepidote, with a rounded to obtuse apex; petals unguiculate with a long linear claw and a widely obovate blade, 1.9–2.1 × 1–1.2 cm, free, the blade spreading to reflexed, with undulate margins, pale blue, with whitish base, obtuse. Stamens: included, erect, 1.6–2.1 × 0.4–0.6 mm; filaments flattened, sublinear, whitish, slightly translucent, 1.1–1.4 × 0.04–0.06 cm, free; anthers yellowish, 1.4–1.6 × 0.4–0.6 mm. Pistil: exceeding the stamens; ovary greenish, obovate, 1.9–2.2 × 0.12–0.16 cm; style erect, whitish, 4–4.2 × 0.6–0.7 mm; stigma simple-truncate. Capsules and seeds: not seen.

Conservation comments. In Bahia, this species occurs on the inselbergs in the Atlantic Forest and Caatinga ecotone at the Bahia–Minas Gerais border in the municipality of Cordeiros. In Bahia, this species is relatively rare and is threatened by the frequent fires in the region.

Tillandsia linearis Vell.

New records. BRAZIL – Bahia • Itapebi, near Bridge of the Jequitinhonha River, 15°57.15′S, 039°33.65′W, 15 Dec. 2003, J.E. Santos s.n. (HURB 23932). • Itapebi, Caiubi District, Near the Jequitinhonha River, Salto da Divisa, 15°58.39′S, 039°51.46′W, Jan. 2020; E.H. Souza 204 (HURB 25808).

Identification. Plant: epiphytic, 18–28 × 1.2–2 cm when flowering, inconspicuous stem. Leaves: 14–19.5 × 0.2–0.4 cm, numerous, polystichous, erect to suberect, green to reddish, chartaceous, slight sulcate; sheaths similar to the leaf blades in color, oblong, 0.6–0.9 × 0.4–0.6 cm, lepidote; leaf blades 11–18.5 × 0.2–0.3 cm, linear with a long-attenuate apex, green to reddish, lepidote. Inflorescence: (fertile portion) simple, complanate, 3.0–4.2 × 0.7–1.1 cm, 3–5 flowers per inflorescence. Peduncle: 16–22 × 0.18–0.25 cm, erect to suberect, green to reddish, covered by peduncle bracts; peduncle bracts foliaceous, the basal ones being lepidote, narrowly triangular with an attenuate apex, 2.8–4.2 × 1.7–2.1 cm, and the distal reddish, lepidote, elliptic with attenuate apex, 1.5–2.0 × 1.1–1.6 cm. Floral bracts: elliptic to lanceolate, 2.0–2.4 × 0.6–0.9 cm, reddish, covering the calyx and exceeding the sepals in length, not carinate, lepidote with an acute apex. Flowers: sessile, distichous, 3.5–4.1 × 1.2–1.5 cm; sepals lanceolate, 1.2–1.4 × 0.3–0.5 cm, slightly connate at the base, carinate, glabrous to slightly lepidote with an acute apex; petals unguiculate with a long linear claw and a widely obovate blade, 1.9–2.2 × 0.2–0.4 cm, free, the blade spreading to reflexed, with undulate margins, pale blue, with whitish base, obtuse. Stamens: included, erect, 1.7–2.3 × 0.4–0.7 mm; filament flattened, sublinear, whitish, slightly translucent, 1.2–1.5 × 0.05–0.06 cm, free; anthers yellowish, 1.4–1.5 × 0.4–0.5 mm. Pistil: exceeding the stamens; ovary greenish, obovate, 2–2.3 × 1.3–1.7 mm; style erect, whitish, 4–4.7 × 0.7–0.8 mm; stigma simple-truncate. Capsules and seeds: not seen.

Conservation comments. In Bahia, only small populations were observed in narrow riparian forests along the Jequitinhonha River, where there is great anthropogenic disturbance from deforestation for crops and pastures.

Additionally, plants are being collected for sale as ornamental plants.

***Tillandsia pruinosa* Sw.**

New record. BRAZIL – Bahia • Brejões, Serrana District, Camaçari Farm; 13°07.23′S, 039°53.07′W; 7 Jul. 2018, E.H. Souza et al. 134 (HURB 25810).

Identification. Plant: epiphytic, 10–13.8 × 8.3–13 cm when flowering, inconspicuous stem, pseudobulbous rosette. Leaves: 3.2–10.4 × 0.3–0.6 cm, few in number, polystichous, suberect to contorted, gray-green to silver, chartaceous, sulcate; sheaths distinguished, orbicular, 1.5–3.3 × 1.8–3.2 cm, conspicuously inflated, forming small pseudobulbs, sheaths dark chestnut brown adaxially, densely pruinose-scaly; leaf blades 3.2–8 × 0.3–0.6 cm, narrowly triangular with acute apex. Inflorescence: (fertile portion) simple, 2.1–3.2 × 1.3–1.5 cm, 2–5 flowers per inflorescence. Peduncle: 1.2–1.6 × 0.4–0.6 cm, erect, greenish to cinereous, covered by peduncle bracts; peduncle bracts foliaceous, the basal ones density lepidote, imbricate, narrowly triangular with attenuate apex, 7.0–8.1 × 1.1–1.4 cm, the distal bracts densely lepidote, greenish to pale rose, orbicular with a cuspidate apex, 1.5–2.1 × 0.8–1.1 cm. Floral bracts: elliptical with cuspidate to apiculate apex, imbricate, 1.6–2.5 × 0.6–1 cm, greenish to pale rose, covering the calyx and exceeding the sepals, not carinate, densely lepidote. Flowers: sessile, distichous, 3.2–4.2 × 0.3–0.5 cm; sepals elliptical to lanceolate with acute apex, 1.2–1.4 × 0.5–0.6 cm, slight connate at the base, adaxially carinate, glabrous, green-yellowish; petals ligulate with acute apex, 2.8–3.8 × 0.2–0.4 cm, whitish with a blue-violet acute apex. Stamens: exserted, erect, 3.2–3.4 × 0.08–0.11 cm; filaments flattened at the base and cylindrical distally, linear, whitish at the base and blue-violet distally, 3.6–4.1 × 0.07–0.12 cm, free; anthers brown, 1.8–2.5 × 0.6–0.8 mm. Pistil: exserted and equaling the stamens in length; ovary ovoidal, green to whitish, 5–7 × 1.5–2 mm; style erect, white, 2.2–2.9 × 0.09–0.1 cm; stigma conduplicate-spiral. Capsule: 3.3–5.1 × 0.5–0.7 cm, cylindrical, glabrous, acute apex. Seeds: 2–2.2 mm long, fusiform, appendage 1.3–1.6 cm long.

Conservation comments. This epiphytic species occurs in a small, 5 km^2 area in a semi-deciduous forest with low vegetation in the municipality of Brejões. This species is rather rare in the state. At the locality of the new record, this species is threatened by logging, clearing for pastures, and monotypic agriculture.

Discussion

The genus *Tillandsia* in Bahia is widely distributed in three biomes, the Atlantic Forest, Caatinga, and Cerrado, butthe five species reported here have a small geographical distribution in the state (Flora do Brasil 2020). All of these five species have a preference for xeric habitats, occurring in forests bordering Caatinga areas, often with rupicolous habitat. Our fieldwork found the first records of five species of *Tillandsia* in Bahia (Fig. 1).

Tillandsia didisticha is widespread in the Caatinga, Cerrado, Atlantic Forest, and Pampa biomes in Brazil (Fig. 1), as well as in Bolivia, Paraguay, and Argentina. *Tillandsia linearis* has a geographical distribution in Atlantic Forest or Cerrado but with only one record in each of five Brazilian states (Rio de Janeiro, São Paulo, Santa Catarina, Paraná, and Goiás; Smith and Downs 1977; Flora do Brasil, 2020). *Tillandsia dura* is known to occur in Atlantic Forest fragments in Espírito Santo, Rio de Janeiro, São Paulo and Santa Catarina, while *T. grao-mogolensis* is restricted to only Minas Gerais in the Caatinga biome. On the other hand, *T. pruinosa* is widespread in Brazil (Espírito Santo, Minas Gerais, Rio de Janeiro, and Pará), and north through the northern Andes, Central America, and the Greater Antilles to Florida, USA (Smith and Downs 1977; Gouda et al. 2020; Reflora 2020).

Tillandsia didisticha belongs to the subgenus *Anoplophytum* and is morphologically most similar to *T. bonita* Versieux & Martinelli and *T. lorentziana* Griseb. Versieux et al. (2013) differentiated *T. didisticha* from *T. bonita* mainly by the size of the flowers, which have an average length of 2.6 cm (vs 2–2.4 cm), as well as sepal length of 1.5 cm (vs 1.1–1.4 cm), petal length of 2.4 (vs 1.6–2 cm), style length of 1.3 cm (vs 0.9–1.1 cm), color of floral bracts (red vs green), and glabrous to slightly lepidote floral bract (vs entirely lepidote or lepidote only towards the apex), in addition to its restricted occurrence to Parque Nacional da Bodoquena, Mato Grosso do Sul. *Tillandsia lorentziana* has adaxially carinate sepals (vs not carinate sepals). When sterile, it can be confused with *T. pohliana* Mez, which occurs in sympatry. However, *T. didisticha* can be distinguished from *T. pohliana* by its larger stature, about 22–45 cm in length when flowering (vs 16–25 cm in length), and fewer number of leaves (ca 15) which are incurved (vs 26 and normally erect to curved), distichous flower arrangement (vs polystichous), and inflorescence compound with patent branches or rarely simple (vs simple inflorescence). *Tillandsia didisticha* occurs in Bolivia, Argentina, Paraguay, Peru, and Brazil (Goiás, Mato Grosso, Mato Grosso do Sul, Paraná, Pernambuco and Paraíba (Smith and Downs 1977; Flora do Brasil 2020).

Tillandsia dura when sterile can be confused with *T. tenuifolia* L., which also occurs in sympatry. However, it can be distinguished by having a longer inflorescence of 8–15 cm (vs 1.9–4.0 cm in length in *T. tenuifolia*), strongly complanate (vs ovoid), short peduncle of 4.3–5.4 cm (vs 4–9 cm), erect to suberect (vs suberect to pendulous) with 8–18 flowers per inflorescence (vs 6–8 flowers), and distichous flower arrangement (vs polystichous). *Tillandsia dura* belongs to the subgenus *Aerobia* and has a simple inflorescence, ligulate, erect to suberect, or reddish, distichous flowers. The leaves are numerous, polystichous, erect to curved, arranged along the stem, green to reddish, slightly sulcate, densely and

finely appressed-lepidote, subglabrous above with age, and chestnut-brown for all the sheath and much of the blade, with the remainder gray-green when dry and rigid. This trait sets it apart from the other sympatric species. *Tillandsia dura* it is an epiphyte which occurs in Atlantic Forest fragments in Espírito Santo, Rio de Janeiro, São Paulo, and Santa Catarina.

Tillandsia grao-mogolensis was considered endemic to Minas Gerais, with only six records from the municipalities of Grão Mogol, Porteirinha, Boenópolis, Pedra Azul, and Santana do Riacho where it occurs on inselbergs in Cerrado and Atlantic Forest areas (Flora do Brasil 2020). This species is morphologically most similar to *T. streptocarpa* Baker, *T. arhiza* Mez, and *T. itatiensis*, but it can be recognized by its smaller size (20 cm) and in having an erect stem, pilose leaves and non-curved apex, simple inflorescence with 5 or 6 flowers, and violet petals. *Tillandsia streptocarpa* is larger (30–70 cm), with a short stem, lepidote leaves with curved apex, inflorescence compound to rarely simple, more numerous leaves (12–30), and slightly perfumed lilac to violet petals. The recently described *T. itatiensis* is medium-sized (30–48 cm), with a curved stem, lepidote to cinereous leaves, simple inflorescence with few flowers (3–5), and pale blue petals (Leodegario et al. 2020). *Tillandsia arhiza* is only recorded in Paraguay and does not occur in Brazil.

Tillandsia linearis is endemic to Brazil, occurring in Rio de Janeiro, São Paulo, Santa Catarina, and Paraná. In São Paulo, this species was presumed to be extirpated until 2007 (Wanderley and Martins 2007). In Paraná, this species is abundant mainly in mixed ombrophilous forests (Kremer 2011; Flora do Brasil 2020). The main characteristic of *T. linearis* is the linear and delicate leaf blades in the rosette, which become bright red during flowering. The inflorescence has few flowers, which distinguishes *T. linearis* from other species. In the Jequitinhonha Valley region, this species is known as "fireball" due to its clump-like, reddish leaves at sometimes of the year. There is no consensus as to which subgenus *T. linearis* belongs, as it has never been included in any phylogenetic study. Wanderley and Martins (2007) considered it to belong to the subgenus *Anoplophytum* on account of its broad petals, non-plicate filaments, and short style. Gouda et al. (2020) placed it in *Diaphoranthema*, and Benzing (2000) and Tardivo (2002) suggested that it belongs to *Phytarrhiza*. Morren (1879) originally described this species as *Phytarrhiza linearis*, and its petals have a well-expanded lobe and short ovary and pistil, which is suggestive of the subgenus *Phytarrhiza*.

Tillandsia pruinosa has a widespread distribution from the southern United States to the northern Andes and the Greater Antilles extending into Brazil (Gouda et al. 2020). In Brazil, it occurs in Espírito Santo, Minas Gerais, Rio de Janeiro and Pará (Flora do Brasil 2020). This species is morphologically most similar to *T. bulbosa* Hook. on account of its pseudobulbous habit and well-developed, orbicular, and inflated sheaths. *Tillandsia pruinosa* can be differentiated from *T. bulbosa* by its gray-green, dense, spreading, lepidote leaves (vs green, appressed, and lepidote in *T. bulbosa*), small (10–13.8 cm) leaves (vs 16–22 cm), and short (1.2–1.6 cm) peduncle (vs long 5.1–6.2 cm), with 2 or 3 flowers per inflorescence (vs 4–8 flowers). Both belong to the subgenus *Tillandsia* because they have symmetrical sepals, erect and tubular petals, and stamens and style exserted.

Our discovery of the first records of five species of *Tillandsia* in Bahia is an important addition to the knowledge of these species and also contributes data useful towards the conservation biogeographic study of these plants (Versieux et al. 2013; Lima and Soares-Silva 2016). These species were probably overlooked in Bahia as a consequence of the collection gaps in the state, which is the fifth largest state by area in Brazil. Our new records show the need for additional floristic surveys in the state, mainly in the Caatinga and Cerrado biomes.

Acknowledgements

This paper is part of the MSc dissertation of MML, and this study was financed in part by the Fundação de Amparo a Pesquisa do Estado da Bahia (BOL0098/2019). We thank the support from the Coordenação de Aperfeiçoamento de Pessoal de Nível Superior (PROCAD 88887.124186/2014-00). EHS acknowledges the support of CAPES/PNPD/UFRB (88882.315208/2019-01), and FVDS acknowledges the support of Conselho Nacional de Desenvolvimento Científico e Tecnológico (CNPq 304269/2018-2). We also thank Maria da Solidade Oliveira Silva and João Eduardo dos Santos for the assistance in finding the new occurrences; Suzana Martins and João Eduardo dos Santos for the images; the reviewers Dr Walter Till and José Herlânio de Lima; and the editor, Dr Matias Köhler, for their valuable comments and suggestions.

Authors' Contributions

MML and BPC wrote the descriptions. BPC collected the material, made descriptions and writing of the manuscript. MML, BPC, MGLW, LYSA, and FVDS confirmed the identification of the botanical material. All authors participated in the writing of the manuscript. EHS collected, photographed plants in the field, identified the material, wrote descriptions and is responsible for the project funding.

References

Baker JG (1887) Synopsis of Tillandsieae. Journal of Botany 25: 211–214.

Baker JG (1889) Handbook of the Bromeliaceae. George Bell & Sons, London, UK, 264 pp.

Barfuss MHJ, Till W, Leme EMC, Pinzoì NJP, Manzanares JM, Halbritter H, Samuel R, Brown GK (2016) Taxonomic revision of Bromeliaceae subfam. Tillandsioideae based on a multi-locus DNA sequence phylogeny and morphology. Phytotaxa 279: 001–097. http://doi.org/10.11646/phytotaxa.279.1

Benzing DH (2000) Bromeliaceae: profile of an adaptive radiation. Cambridge University Press, Cambridge, UK, 690 pp. https://doi.org/10.1017/cbO9780511565175

Büneker HM, Pontes RC, Witeck-Neto L (2015) Novos registros em *Tillandsia* L. (Bromeliaceae, Tillandsioideae) para o Rio Grande do Sul, Brasil. Rodriguésia, 66 (2): 493–498. https://doi.org/10.1590/2175-7860201566216

Fiorato L (2009) O gênero *Tillandsia* L. (Bromeliaceae) no estado da Bahia, Brasil. PhD dissertation, Instituto de Botânica da Secretaria de Estado do Meio Ambiente, São Paulo, Brazil, 107 pp.

Flora do Brasil (2020) Flora do Brasil 2020. Jardim Botânico do Rio de Janeiro, Rio de Janero, Brazil. http://floradobrasil.jbrj.gov.br/reflora/floradobrasil/FB6361/. Accessed on: 2020-11-16.

Givnish TJ, Barfuss MHJ, Ee BV, Riina R, Schulte K, Horres R, Gonsiska PA, Jabaily RS, Crayn DM, Smith JAC, Winter K, Brown GK, Evans TM, Holst BK, Luther H, Till W, Zizka G, Berry PE, Sytsma KJ (2011) Phylogeny, adaptive radiation, and historical biogeography in Bromeliaceae: insights from an eight-locus plastid phylogeny. American Journal of Botany 98: 872–895. http://doi.org/10.3732/ajb.1000059

Gouda EJ, Butcher D, Gouda CS (2020) Encyclopaedia of bromeliads, version 3. http://bromeliad.nl/encyclopedia. Accessed on: 2020-10-12.

Guarçoni EAE, Costa AF, Silva EO, Ferreira AWC, Oliveira MS (2018) New record of *Tillandsia* L. (Bromeliaceae, Tillandsioideae) for Maranhão state, Brazil. Check list 14(6): 951–959. https://doi.org/10.15560/14.6.951

Kremer D (2011) O gênero *Tillandsia* L. (Bromeliaceae-Tillandsioideae) no estado do Paraná, Brasil. PhD dissertation, Universidade Estadual de Ponta Grossa, Ponta Grossa, Brazil, 165 pp.

Leodegario MM, Cavalcante BP, Aona LYS, Wanderley MGL, Souza EH (2020) *Tillandsia itatiensis*: a new species of *Tillandsia* L. (Bromeliaceae) from Bahia, Brazil. Phytotaxa 456 (2): 186–194. https://doi.org/10.11646/phytotaxa.456.2.6

Lima JH, Soares-Silva LH (2016) Two new records for Bromeliaceae in the central-west region of Brazil: *Vriesea friburgensis* and *Tillandsia polystachia*. Rodriguésia 67 (4): 1093–1100. https://doi.org/10.1590/2175-7860201667419

Mez C (1895) Bromeliaceae. In: Martius CFP, Eichler AG, Urban I. Flora Brasiliensis. Leipzig, München, Germany, 172–634.

Morren É (1879) Bulletin des nouvelles et de la bibliographie. La Belgique Horticole 29: 301.

Pontes RAS, Agra MF (2006) Flora da Paraíba, Brasil: *Tillandsia* L. (Bromeliaceae). Rodriguésia 57 (1): 47–61. 2006. https://doi.org/10.1590/2175-7860200657104

Reflora (2020) Plantas do Brasil: resgate histórico e herbário virtual para o conhecimento e conservação da flora Brasileira. http://reflora.jbrj.gov.br/reflora/PrincipalUC/PrincipalUC.do. Accessed on: 2020-10-18.

Scharf U, Gouda EJ (2008) Bringing Bromeliaceae back to homeland botany. Journal of the Bromeliad Society 58: 123–129.

SEI (Superintendência de Estudos Econômicos e Sociais da Bahia) (2014) Físico-ambientais - mapas estaduais. https://www.sei.ba.gov.br/index.php?option=com_content&view=article&id=2669&Itemid=710. Accessed on: 2020-10-18.

SEMA (Secretaria do Meio Ambiente) (2020) Projeto biomas e ecossistemas da Bahia. http://www.meioambiente.ba.gov.br/modules/conteudo/conteudo.php?conteudo=133. Accessed on: 2020-10-18.

Siqueira-Filho JA, Leme EMC (2006) Bromeliad taxonomy in Atlantic Forest fragments of Pernambuco and Alagoas. In: Siqueira-Filho JA, Leme, EMC (Eds) Fragments of the Atlantic Forest of northeast Brazil. Biodiversity, conservation and the bromeliads. Andrea Jakobsson Estúdio Editorial, Rio de Janeiro, Brazil, 191–381.

Smith LB, Downs RJ (1977) Tillandsioideae (Bromeliaceae). Flora Neotropica Monograph 14: 663–1492.

SpeciesLink (2020) SpeciesLink. http://www.splink.org.br/. Accessed on: 2020-10-18.

Tardivo RC (2002) Revisão taxonômica de *Tillandsia* L. subgênero *Anoplophytum* (Beer) Baker (Bromeliaceae). PhD thesis, Universidade de São Paulo, São Paulo, Brazil, 238 pp.

Thiers B (2020) Index herbariorum: a global directory of public herbaria and associated staff [continuously updated]. New York Botanical Garden's Virtual Herbarium. http://sweetgum.nybg.org/science/ih. Accessed on: 2020-10-18.

Versieux LM, Vasconcellos N, Martinelli, G (2013) A new species of *Tillandsia* from Mato Grosso do Sul, Brazil, with notes on leaf anatomy. Systematic Botany 38(1): 1–7. https://doi.org/10.2307/23362737

Wanderley M, Martins S (2007) Bromeliaceae. In: Wanderley M, Shepherd G, Giulietti A (Eds) Flora fanerogâmica do estado de São Paulo, vol. 5. Instituto de Botânica, São Paulo, Brazil, 1–494.

Winkler S (1982) Die Bromeliaceae von Rio Grande do Sul. Documenta Naturae 3: 1–90.